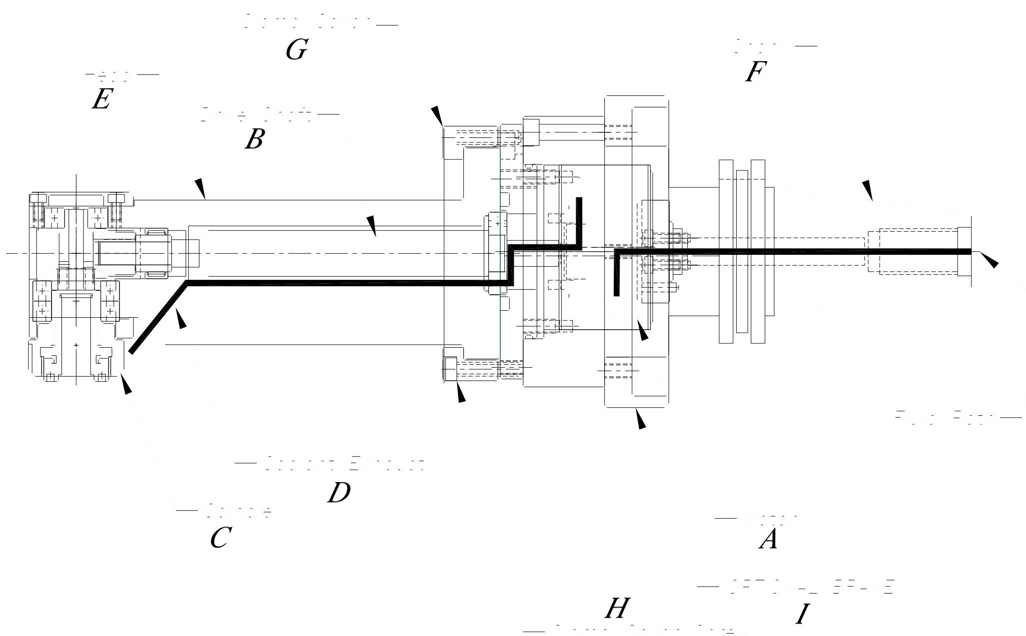
Operation and Maintenance Manual
Titespot® Coolant Driven Angle Heads
Eltool Corporation

Major Components

Figure l



Basic Operation: High pressure coolant enters the Titespot® Angle Head and drives an integral **positive displacement ball piston motor (A).** The motor is coupled to a **drive shaft (B)** which in turn drives the **spindle(C)**. **Exhausted coolant (D)** is directed at the cutter.

Note: For machines not equipped with through spindle coolant delivery, Din B, coolant induced toolholders or other options are available. Please consult factory.

Before Installing Your Titespot® Angle Head

Titespot® High Pressure Coolant Driven Angle Heads are powered hydraulically by a positive displacement ball piston motor. With proper attention to coolant cleanliness and angle head conditioning prior to storage, they require minimum maintenance.

1. Coolant Filtration: It is essential that coolant delivered to the angle head be free of contaminant. We recommend a 50 micron pre-filter then **10 micron filtration or less**, preferably on the pressure side of the delivery system.

2. Coolant Type: Any high quality coolant is acceptable for use, provided it contains a rust preventative and lubricating agents.

Important! After Using Your Titespot® Angle Head

If the angle head is to be taken out of service in excess of 48 hours it is essential to flush and condition the tool as described below. **<u>Failure to follow this procedure may result in residual coolant coagulation rendering the tool inoperable.</u>**

A. Blow high pressure **filtered** air through the retention knob, until all residual coolant is flushed from the tool.

B. Squirt an oil (WD-40, or automatic transmission fluid or similar) into the tool through the retention knob.

C. Blow air through the retention knob until oil is observed exiting the tool around the spindle bearing.

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D. As with any tool holder, coat the external surface with oil and store in a clean, dry place.

Maintenance Notes:

Most failures are not due to wear or use.

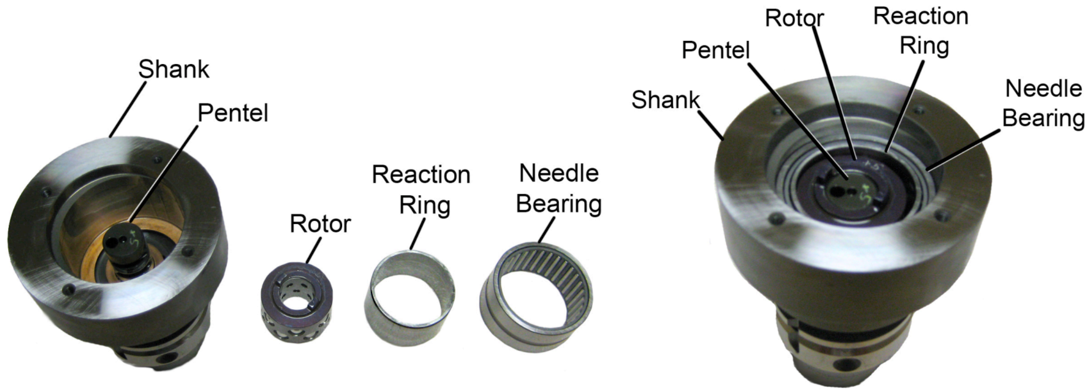
Most failures are the result of:

Improper storage of an unused tool
When a tool is not going to be used for an extended period of time or is being returned for repair it is important that coolant is not left inside the tool to dry up, harden or even corrode the tool. The instructions above give the procedure to prevent this mode of failure.
This is the most common maintenance issue we observe.

Insufficiently clean coolant
This can be due to improper filtration or coolant changes being too infrequent.
We recommend a 50 micron followed by a 10 micron filter on the pressure side of the coolant pump.
Often materials such as cast iron and even aluminum can collect in even a well filtered sump. These particles must be occasionally removed by draining, cleaning and refilling the sump. While our tools are not overly sensitive to this, cleanliness will prolong the life

of the bearings and motor. New tools tend to be more prone to “lock up” if the coolant contains particles than do tools with some working hours on them.

How to Maximize Motor Life



The reaction ring tends to be the first part to wear. It is inside the shank surrounding the motor and is the inner race of the large needle bearing. The ball pistons in the motor’s rotor push against this ring as it slowly rotates. The ring is mounted in such a way that the balls do not ride on it symmetrically. You can extend the life of the motor by tracking hours and flipping the ring after approximately 250 hours of use. Some applications may benefit from more or less hours depending on such factors as coolant cleanliness and severity of the application. If hours are tracked this frequency can be adjusted for maximum motor life. The procedure can be performed in about 15 minutes.

Orienting the Angle Head for Single Position Machining

Initial Orientation: Because the tool changer typically loads the tool against the same side of the keyway each cycle, it is important that **the angle head be loaded by the tool changer,** not by hand, prior to final adjustment.

Final Adjustment: **The head (E)** is attached to the **shank (F)** by means of a **clamp collar (G).** By loosening the four **clamp collar screws (H)** the head can be rotated 360 degrees to the desired orientation. **See Figure l.**

Orienting the Angle Head for Multi-position Machining

On machines with a C Axis: The C Axis can be used to orient the machine spindle to any position required.

On machines without a C Axis:
On machining centers equipped with a servo and encoder (as used in rigid tapping) it is usually possible to re-orient the spindle to the desired machining angle(s) by altering the parameter for the M-19 tool change position. The following procedure and G code applies to machines with **Fanuc** controls. A

similar approach will work on most machine tools however the exact coding and parameter numbers may vary depending on the machine or control.

This is the exact code and procedure with additional explanation to follow.

1. Find and record the value of parameter N4077.

2. Add these lines to your part program for each desired angle:

```
M19              (Orient Spindle)
G10 L50          (Access L50 parameter page)
N4077 P1 R(xxx)  (Parameter No., Bit No., New Value(xxx) )
G11              (Turn off G-10)
M19              (Reorient to new position)
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3. Prior to tool change repeat procedure to return Parameter N4077 to its original value. Note: “R” value will be in encoder pulses. You may have to experiment to determine “pulses per degree”.

On Fanuc controls the spindle encoder typically has 4096 pulses per revolution. This means you would add 11.3778 pulses per desired degree of spindle rotation. (4096/360) Other machines may have encoders with different counts. You can call your machine tool builder and ask for this information. However some experimentation with different values is usually faster.

An explanation of the M19 cycle is helpful to understand how we are using this code to index your spindle. When your control sees an M19 request it slowly rotates the machine tool spindle “looking” for the marker pulse on the encoder. (encoders have one discrete pulse marking “zero”. This is called the marker pulse). When it sees the marker pulse it will count out however many pulses are stored in the orient parameter (N4077 on Fanuc). In that position it will lock up the spindle.

Example: You find parameter N4077 had a value of 500 and you have determined that you have a 4096 count encoder. You have aligned the head using the procedure described above so at spindle orient the tool is pointed to zero degrees. To index the spindle to a 30 degree angle we would change parameter N4077 to 841 (4096/360 = 11.377778 X 30 + 500 = 841.333)

Yes, you will be 1/3 of a pulse off but remember one degree is 11+ pulses. It can be important however not to let this error accumulate. Consider recalculating from the marker pulse each time instead of adding to your current position. If your second hole is an additional 30 degrees change the parameter to 1183 (4096/360 = 11.377778 X 60 + 500 = 1182.666)
To be clear these numbers are typical for the Fanuc control. Your formula may be different. Actual numbers are determined as follows:

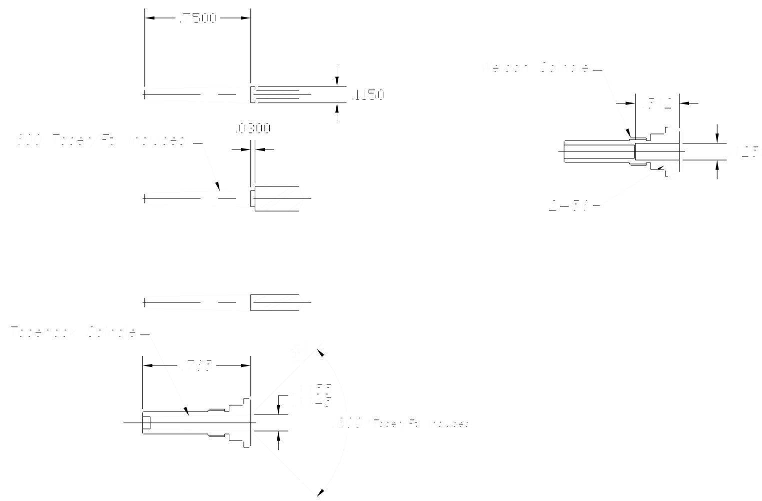
(your spindle encoder count/360 = pulses per degree of rotation X desired index in degrees + initial parameter count = new parameter value)

Occasionally a machine will have radial "play" in the orient position. The amount of play the servo will tolerate is also determined by a parameter. This play can almost always be tightened up to an acceptable level by adjusting this parameter. In the rare cases where it can not be or in applications where the radial load on the spindle exceeds the servos capacity **Eltool has optional spindle clamps and brakes available**. This should be your last resort however as this issue can almost always be resolved via a parameter adjustment.

Selecting the Proper Spindle: If space restrictions are not a consideration, it is generally recommended that a standard, commercially available spindle (ER-ll or ER-16) be selected. For **confined space applications, Eltool offers proprietary spindles** designed to minimize the profile of the angle head.

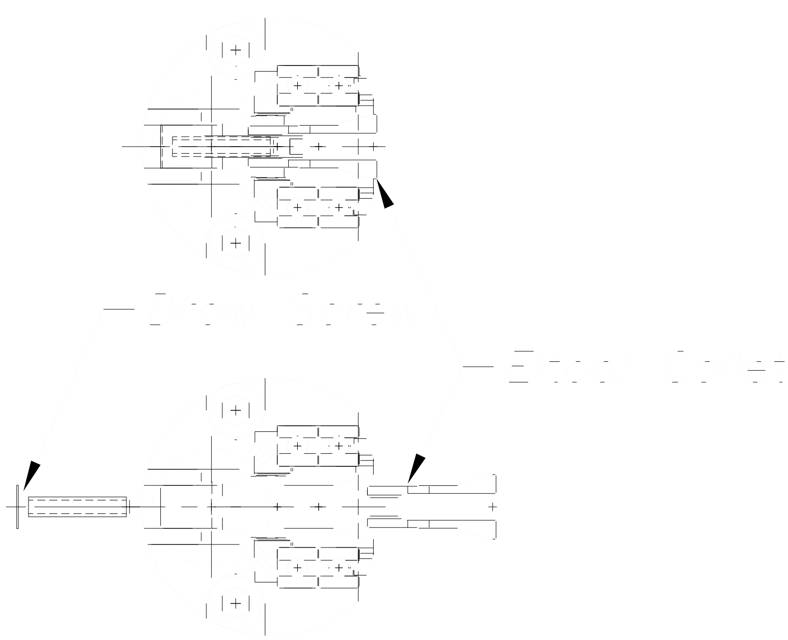
Taperlock Spindles (Size l Heads): Like a morse taper, the shank of the cutting tool is held in place by the binding action of the tapered spindle. **Special geometry is required on the tool shank when using this spindle, as shown below.**

Taper-lock tool shank and spindle geometry



Draw Type (Eltool) Collet (Size 2, 2M, 3 Heads): The spindle accepts a tapered, internally threaded draw collet. The collet is drawn tightly into the spindle by a 6/32 draw screw (5/16 hex head) located on the back face of the angle head. A spanner wrench (supplied with the angle head) holds the spindle in place during the tightening process.

Draw type (Eltool) Collet Assembly and Exploded View



Controlling Angle Head RPM: Cutter RPM is directly proportional to coolant flow rate through the positive displacement ball piston motor. At 70% volumetric efficiency the .18 cu. in/rev motor will rotate at approximately 900 rpm per gpm coolant flow**. If a lower rpm is desired,** this can be accomplished in several ways.

If the High Pressure Coolant System is a Variable Flow Type, rpm can be controlled by adjusting the output flow of the HPCS.

If the High Pressure Coolant System is a Fixed Flow Type

l. Flow can be controlled by threading a ¼ NPT pipe plug into the retention knob, drilled with an orifice sized to deliver the desired flow at the system pressure specification. The chart below specifies orifice sizes for various output flows at a l000 psi system pressure. For pressures other than l000 psi, consult factory. **Note: The plug should be drilled prior to assembly to avoid chip contamination of the angle head.**

Orifice Reference Chart
1000 PSI

Orifice Dia.	Volume (GPM)	Horsepower Required
0.010	0.1	0.1
0.015	0.3	0.2
0.020	0.5	0.3
0.025	0.7	0.5
0.030	1.0	0.7
0.035	1.4	1.0
0.040	1.8	1.2
0.045	2.3	1.6
0.050	2.8	1.9
0.055	3.4	2.4
0.060	4.1	2.8
0.065	4.8	3.3
0.070	5.6	3.8
0.075	**6.4**	**4.4**
0.080	7.3	5.0
0.085	8.2	5.6
0.090	9.2	6.3
0.095	10.3	7.0
0.100	11.4	7.8
0.105	12.5	8.6
0.110	**13.8**	**9.4**
0.115	15.0	10.3
0.120	**16.4**	**11.2**

Example: A high pressure coolant system delivering 8 gpm flow rate will produce a cutter speed of approximately 7200 rpm (8 gpm x 900 rpm/gpm = 7200 rpm) for a l000 psi system. To reduce flow, and rpm, by approximately 50%, a .060 orifice is required.

2. Fine Adjustment (Size 3 and 3M only): Coolant flow can be "fine tuned" by means of a **metering screw** located on the front face of the angle head.

3.Gear reducer/Torque Multiplier: When lower speed and higher torque is required, we recommend the use of our **Model 521 Torque Multiplier.** The Model 521 incorporates a planetary gear with a 5 to l gear ratio and is capable of developing up to l00 inch lbs. of torque. The Model 521 is available as original equipment or as a retrofit.

Modular Design: Titespot® Angle Heads are modular, allowing **l00% interchangeability** between heads and shanks, a potential cost savings where multiple applications for different sized heads or shank styles are contemplated. **Consult factory for pricing of heads or shanks only.**

Customer Support: Please call or email us with any questions concerning our product or your application.

Website: www.eltool.com
Phone #: 1-877-435-8665 (toll free in U.S.)
1-513-723-1772
Email: info@eltool.com
Tech support contact: John Young